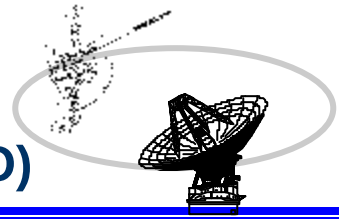
Resource Allocation Review Board (RARB) and DSN Scheduling Metrics

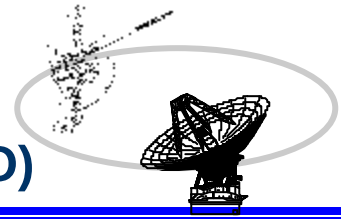
David Morris

March 18, 2005



Agenda

- Abstract
- Introduction
- Purpose
- Background
- Methodology
- Analysis
- Results
- Summary

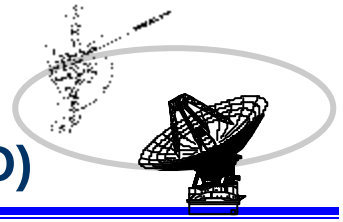


Abstract

This is a study of the present DSN Scheduling System. The DSN Scheduling process is inherently a collegial process that allows users to work together to solve resource contention due to multiple overlapping mission requirements for spacecraft communication. Three areas where products are available were sampled to collect metrics that may guide the development of a future scheduling system. In long range scheduling, Resource Allocation Review Boards publish "Redbooks" that document what initial planning is done to alleviate oversubscription. Significant impacts to this planning are NASA HQ changes to the Mission Set. An inspection of recommendations in a single month over multiple reviews indicates 52% suggest deletion or reduced mission support. In the mid-range scheduling process, an evaluation of the initial allocation of resources in a small sample of "Preview Week Schedules" show an average of 27 conflicts over 360 tracks supporting 42 unique users with 31% involving more than two parties. One of the reasons the number of conflicts is low is because the five missions at Mars utilize Multiple Spacecraft Per Aperture (MSPA) capability effectively. During a six month sample where they made up 20% of the tracks per week, an average 82% of the Mars tracks use MSPA.

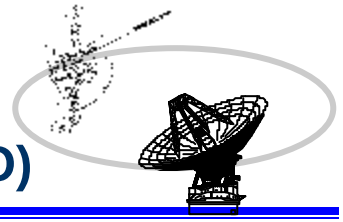
Introduction

- **R. Bartoo Asked D. Morris to Analyze RARB Analysis and Recommendations**
  - ***Look at Seven RARB Redbooks in Detail and Provide Detailed Analysis to Characterize the Conflicts***
- **Met with R. Bartoo and R. Miller**
  - **Provided Study Estimate on Analysis – Too Long**
  - **Clarified Purpose of Study, Replanned Methodology and Analysis**
- **Welcome the Opportunity**
  - **Collect RARB Metrics**
  - **Evaluate Preview Week Generation and Methodology**
  - **Quantify the Importance of Multiple Spacecraft Per Aperture (MSPA)**



Purpose

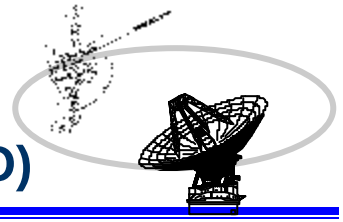
- **To Evaluate the Complexity Needed of a Future DSN Scheduling System by Looking at Present Products**
  - **Analyze RARB Recommendations Over Multiple Meeting Epochs**
  - **Use Preview Weeks To Quantify Conflicts and Ascertain the Number of Parties Involved**
  - **Quantify Mars Missions' Use of MSPA as an Example of Multi-Party Conflict Resolution**



Background

Scheduling Process Summary:

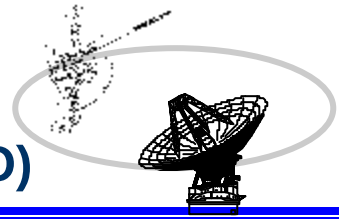
- **Long-Range Planning – RARB (Redbook) or JURAP Meetings as Needed**
  - **~28 Weeks Out And Beyond (ULP Additions & Updates For Load Balancing)**
    - **Resource Load Is Balanced Based On Updated Requirements and Available Capacity In the Forecast Database Before Tracks Are Scheduled at Specific Times.**
- **Mid-Range Scheduling – RAPT Meetings as Needed**
  - **~26-27 Weeks Out (Preview Week Schedules Generated)**
    - **RPS Mid-range Scheduler Generates Two Weeks of Tracking Schedule From Project Requirements (User Loading Profile) While Incorporating a MDAP Generated Schedule ("Mars Integrated") For Mars Missions. This is the First Instance of a Schedule.**
  - **~25-26 Weeks Out (Rap Work Book Schedule Posted)**
    - **RPS Receives Feedback From Missions On Mistaken, Changed, Or More Detailed Requirements To Modify Preview Schedule. The Schedule Is Then Posted As The "RAP Work Book." Mission Representatives Work Out Facility, SOA, BOT and Equipment Conflicts In RAP Team Meeting as Needed.**
  - **~11-24 Weeks Out (Updates To RAP Book)**
    - **Missions Work Out Remaining Equipment Conflicts Among Themselves.**
- **Short-Range Scheduling**
  - **8-11 Weeks Out (Transfer Weeks Posted)**
    - **These Weeks Are Transferred To DSN Scheduling (NSS). They Are Conflict-Free.**



Methodology

- **Analysis of a Specific Month Over Multiple RARB Sessions (June 2006 Picked by R. Bartoo)**
  - **Note Changes to Mission Set and Assets Impacting June 2006**
  - **Evaluate the Analysis and Recommendations Subsections**
    - **Quantify Tracks That Support Each Subnet Analysis**
    - **Quantify Tracks That Have Recommended Changes**
  - **Source Data: RARB Redbook and Supplemental Materials**

    February & August 2003, February & August 2004, and February 2005
- **Analysis of Preview Weeks and Generation Procedures**
  - **Eleven Recent Weeks Available**
- **Analysis of Multiple Spacecraft Per Aperture Support**
  - **Six Months in 2005 Used**



RARB Analysis

- **RARB Metrics for June 2006:**
  - **June 2006 Definition**
  - **Mission Set and Resource Changes**
  - **Quantity of Requested Activities and Hours**
  - **Analyses and Recommendations Rationale**
  - **Taxonomy and Effect of Recommendations**
  - **Analysis Metrics**
  - **Recommendations Metrics**
  - **Analyses and Recommendations**
    - **Percent of Requested Support**
    - **Percent of Analysis**

June 2006 Analysis

- **Typical Month With a Planetary Launch (Dawn), MRO Aerobraking and an Antenna Downtime Planned**
- **Five RARB meetings reviewed this period**

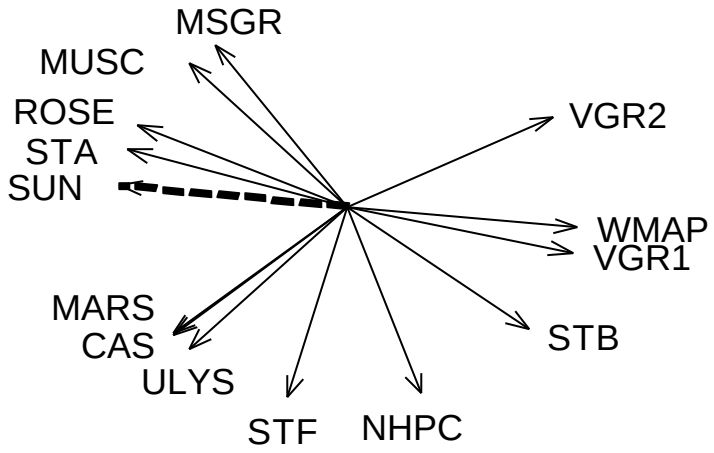
February	**2003**
August	**2003**
February	**2004**
August	**2004**
February	**2005**

- **DOY & Right Ascension Chart:**

June 06

Mo	Tu	We	Th	Fr	Sa	Su	
			1 152	2 153	3 154	4 155	22
5 156	6 157	7 158	8 159	9 160	10 161	11 162	23
12 163	13 164	14 165	15 166	16 167	17 168	18 169	24
19 170	20 171	21 172	22 173	23 174	24 175	25 176	25
26 177	27 178	28 179	29 180	30 181			26

June 2006



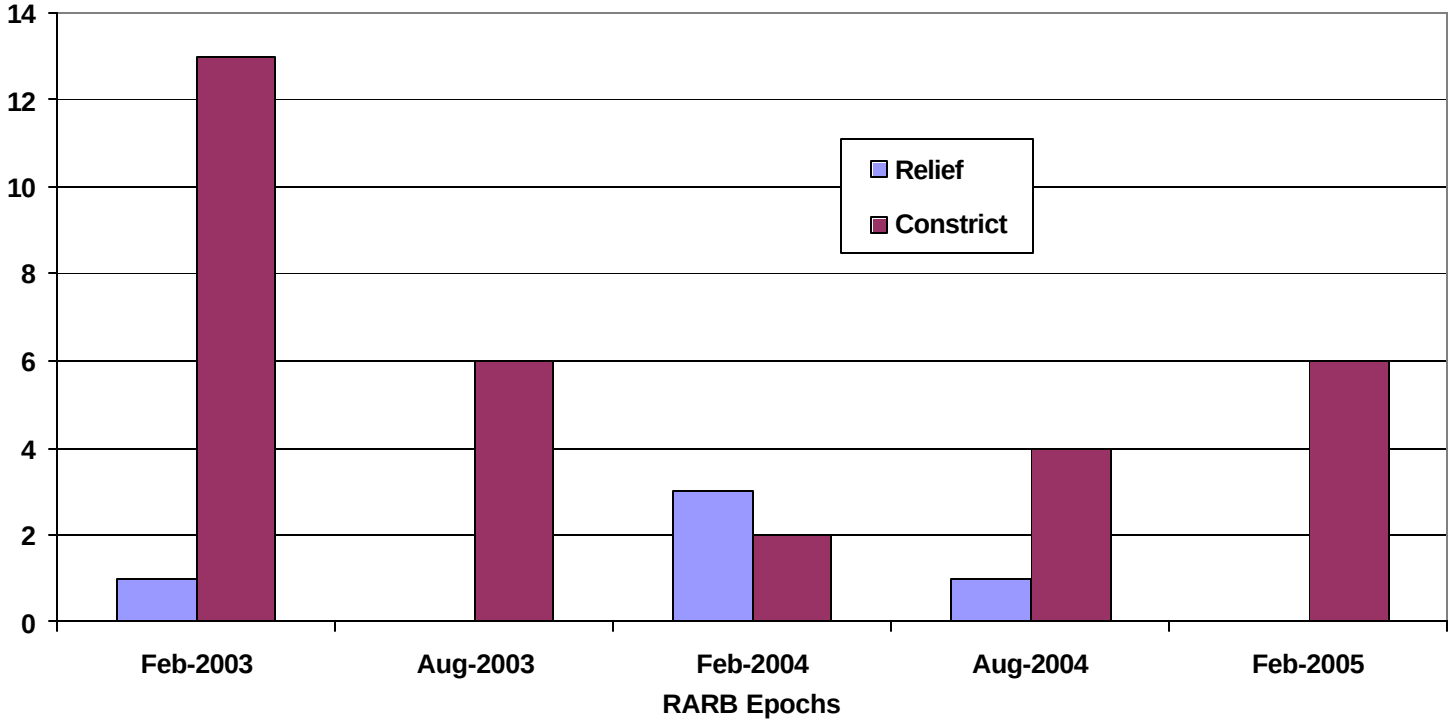
MARS=M01O,MEX,MER1, MER2,MRO,MGS

RARB Mission Set and Resource Changes:

- 36 Major Changes
- 24 NASA HQ Mission Set Changes
- 10 Changes in Mission Requirements (9 Increase)
- 2 Capacity Decreases (DSS-63 Downtime & Increased Setup Time)

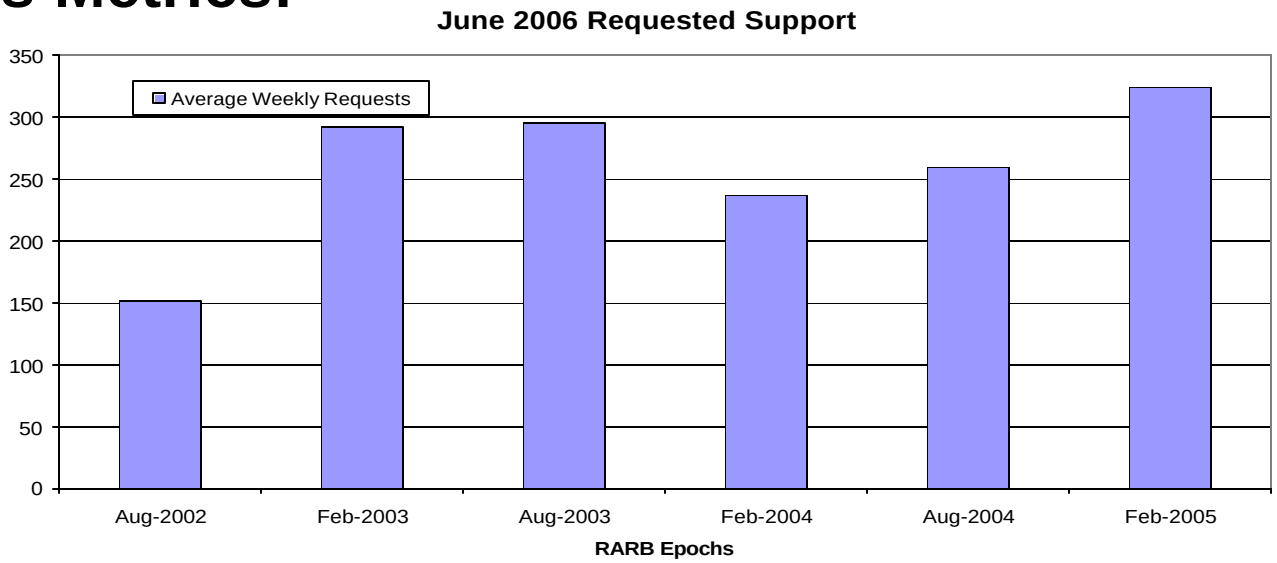
Relief = Requirements are Reduced or Capacity Increased

Constrict = Requirements are Increased or Capacity Reduced



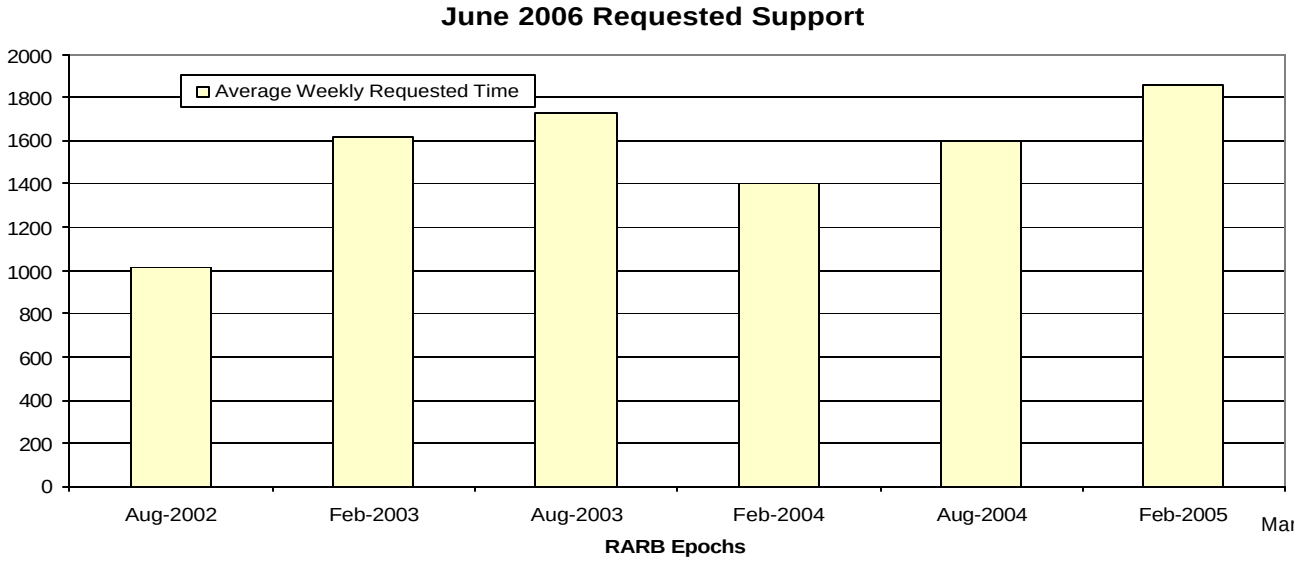
Tracks and Hours Metrics:

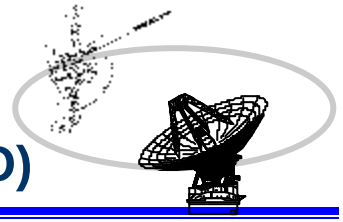
- **Average Weekly Requested Tracks**



- **Average Track Length ~ 6 Hrs Includes Setup and Teardown**

- **Average Weekly Requested Hours**





RARB Analyses and Recommendations Rationale:

1. **Missions Are Surveyed for Up-to-Date DSN Tracking Requirements & Viewperiods – Database Is Updated**
2. **Scheduling Model Forecasts DSN Subnet Capacity Problems and Mission Support Problems**
3. **Monthly DSN Analysis Performed for Completeness; If No Problems, No Recommendations**
4. **Analysis Cites Missions in Specific Problem Areas to Support Recommendations by Focusing on DSN Subnets**
5. **Recommendations Are Specific to a Mission and List Parenthetically Each Supporting Analysis**
   - **Recommendations Cannot Be Unsolicited; There Must Be a Real Reason (Contention) to Suggest a Solution**
   - **Attempt to Move Demand, Reduce Demand or Increase Capacity**
6. **Supplemental Information Provides a Data Set of Mission Requirements**

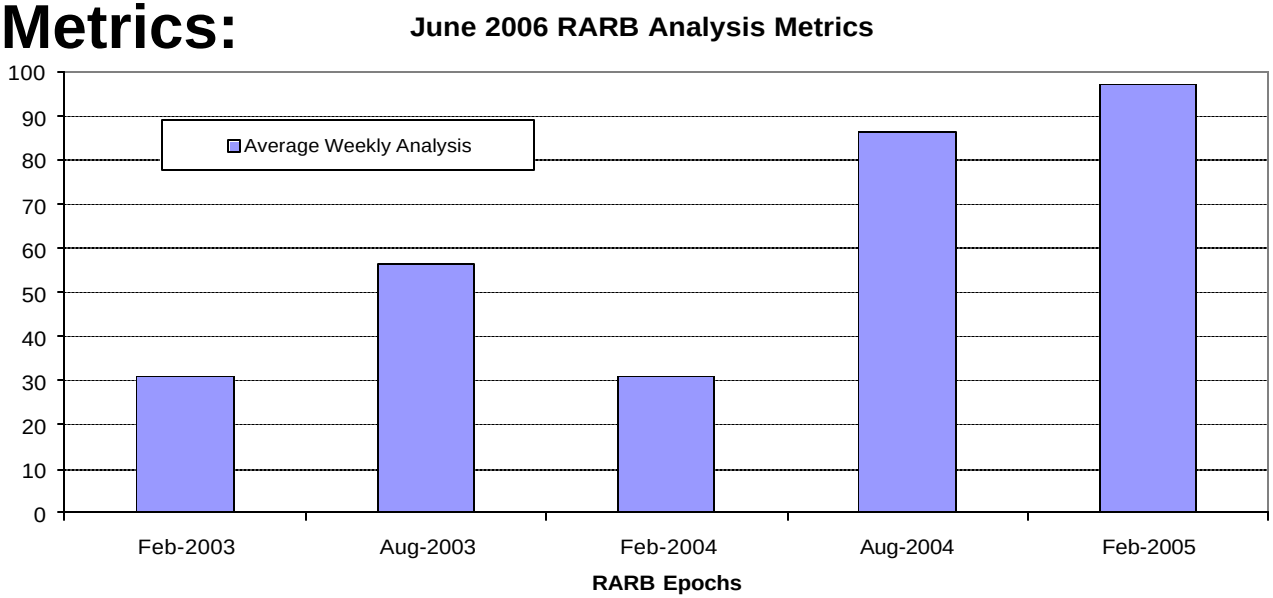
RARB Project Recommendation Taxonomy:

1. Delete
2. Delete and Reduce
3. Delete and Change Antenna
4. Delete, Reduce and Change Antenna
5. Reduce
6. Reduce and Change Antenna
7. Reduce and Move Week
8. Move Out of Week
9. Change Antenna and MSPA
10. Change Antenna

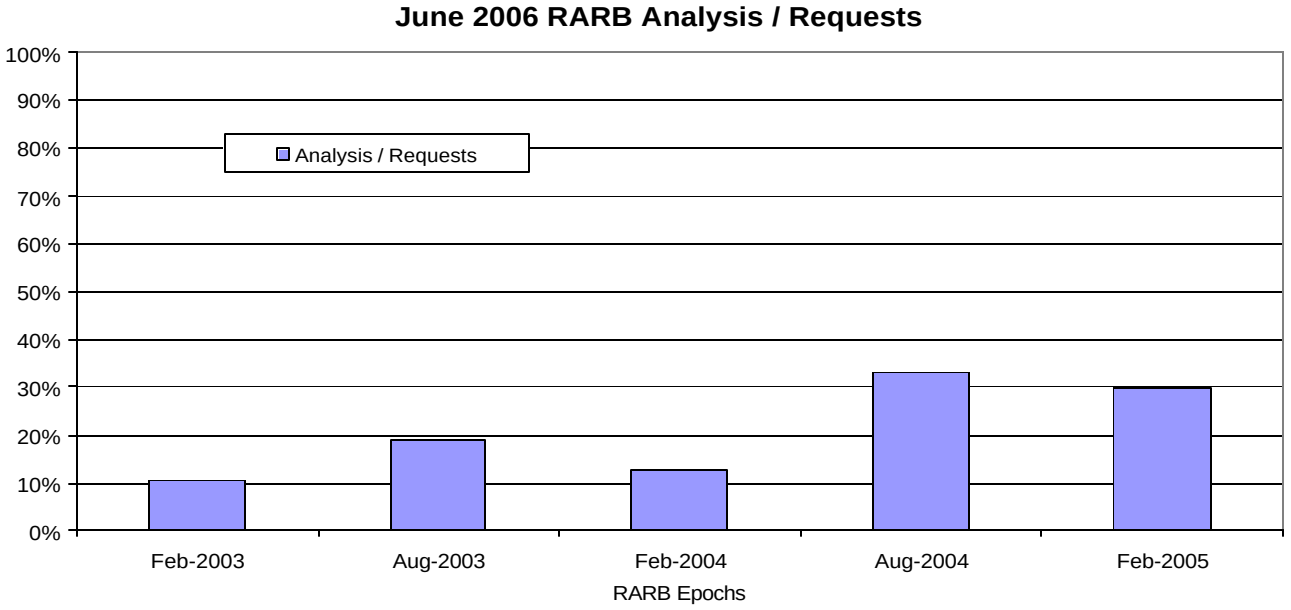
June 2006	
Items	Frequency
1 - 4	27%
5 - 8	25%
9 - 10	48%

RARB Analysis Metrics:

- **Average Weekly Analysis Generally Trends Higher With Each RARB**

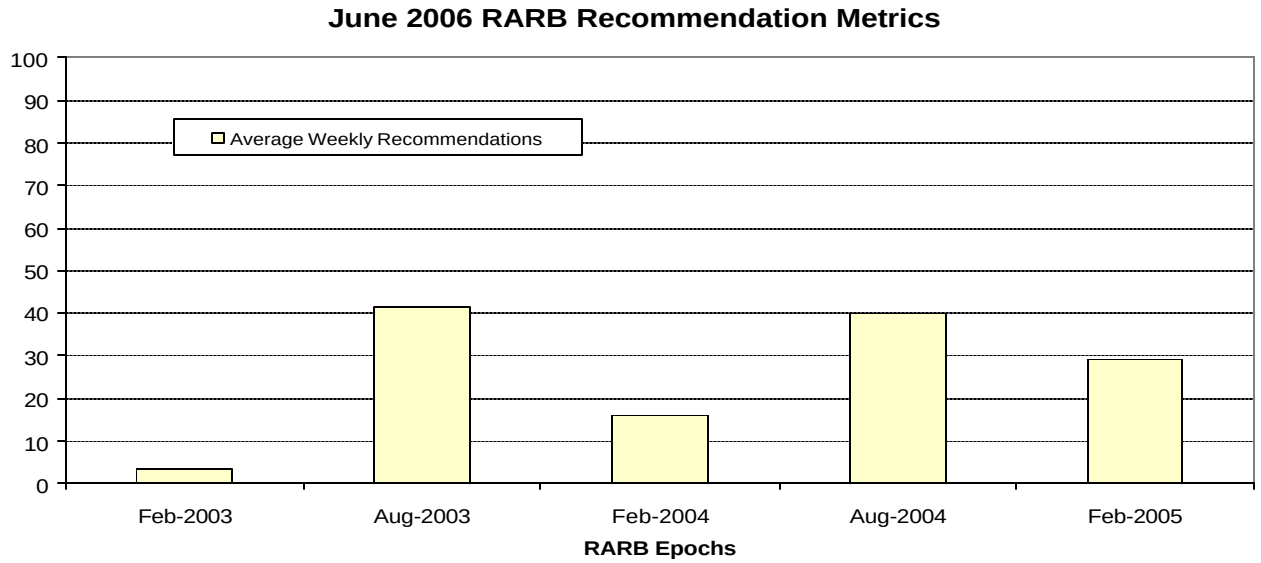


- **11 – 33% Percent of Tracks Form the Basis of RARB Recommendations**

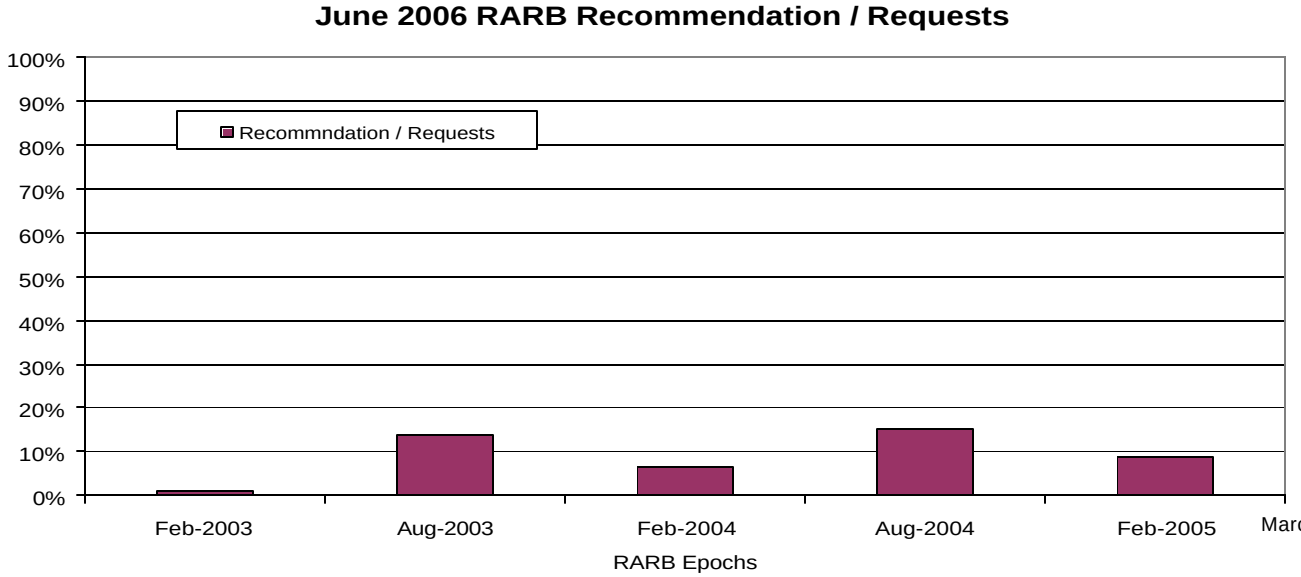


RARB Recommendations Metrics:

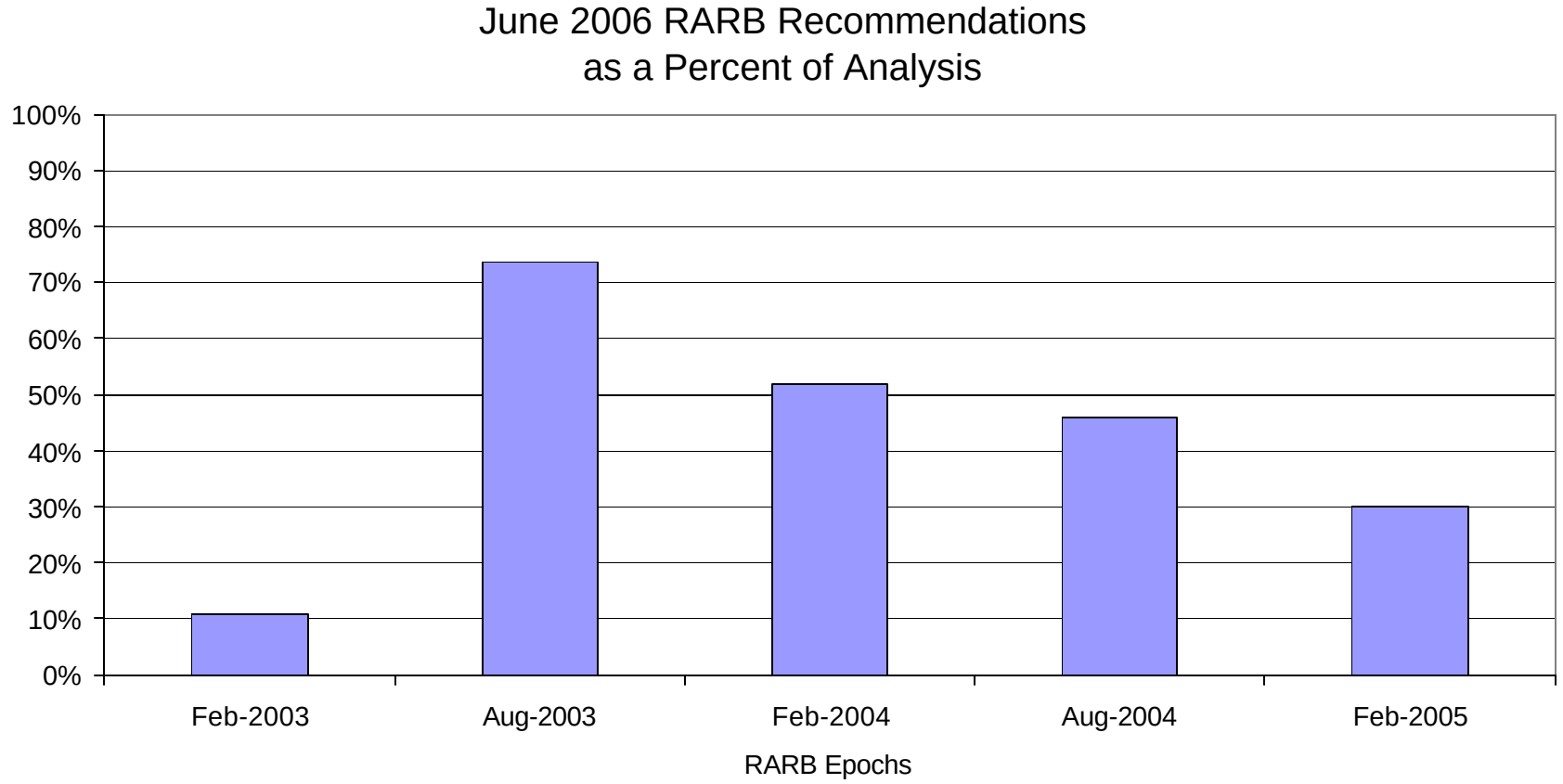
- **Average Weekly Recommendations Range From Below 10 to ~40 per Week**



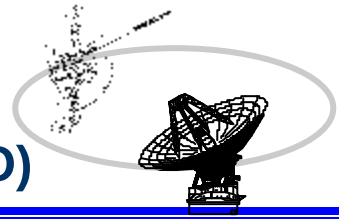
- **1 – 15% Percent of Tracks Are Requested to be Modified by RARB Recommendations**



Resource Allocation Planning & Scheduling Office (RAPSO)



- **Trend Shows a Declining Number of Recommendations Per Analysis or Problem Space**
- **Possibly Infers That Solutions Are Proceeding With an Improving Rate Over Each RARB**

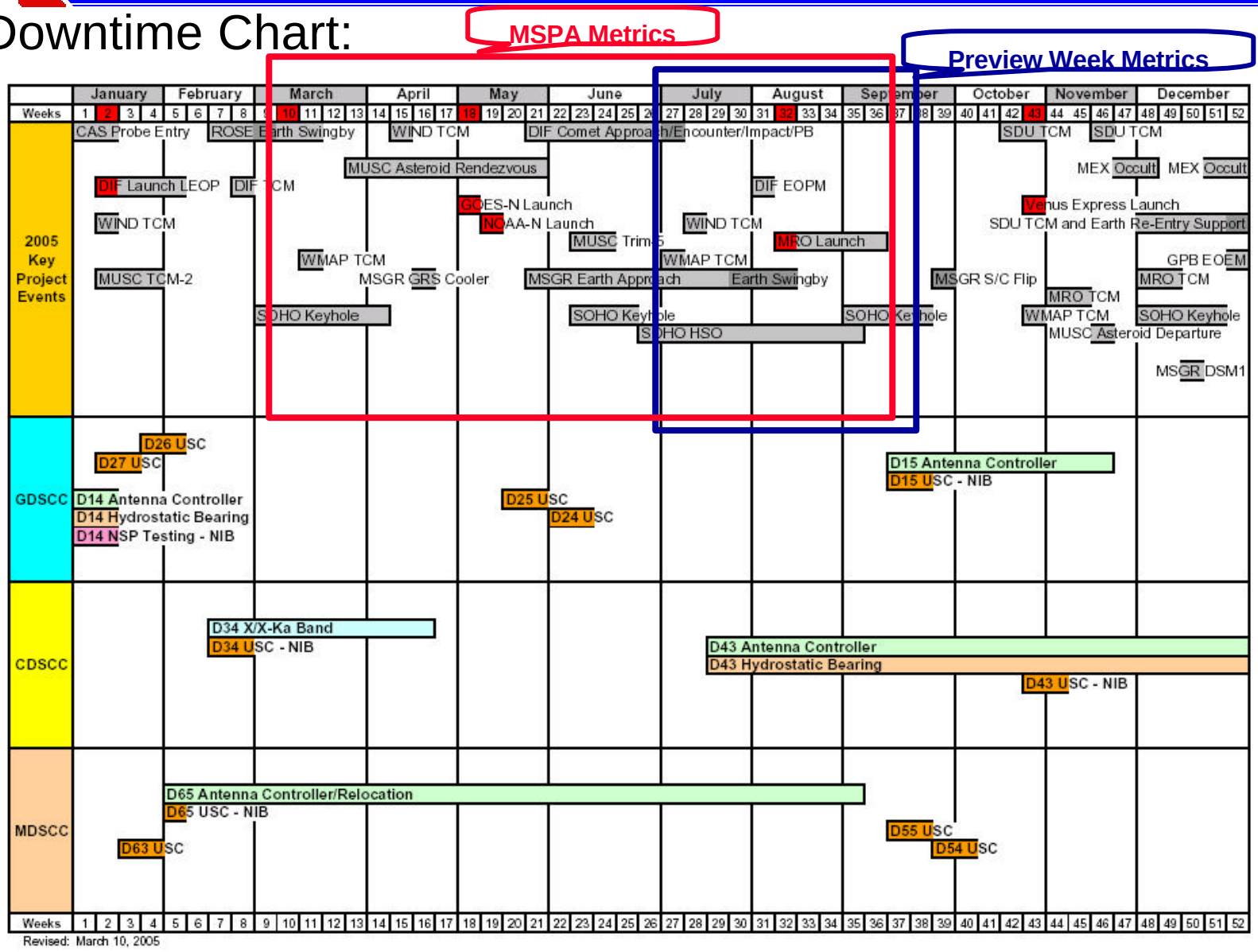


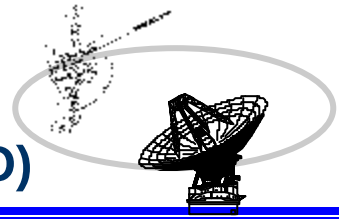
Preview Week and MSPA Analysis Metrics:

- **In Order to Peek at Complexity,**
  - **Generation and Metrics of Preview Weeks (11 Week Sample)**
    - **Number of Requested Tracks**
    - **Number and Taxonomy of Conflicts Identified**
    - **Generation Procedure**
  - **MSPA Metrics (26 Week Sample In 2005)**
    - **Number of 2, 3 and 4 Party Solutions That Are Part of the Weekly Schedule Generation Process**
    - **Percent of the Total Requested Tracks**
    - **Percent of the Total Missions At Mars Tracks (Excludes MRO)**
  - **These Two Products Overlap By 10 Weeks**
  - **Schedules Contain Up to 42 Unique Users**

Resource Allocation Planning & Scheduling Office (RAPSO)

2005 Downtime Chart:



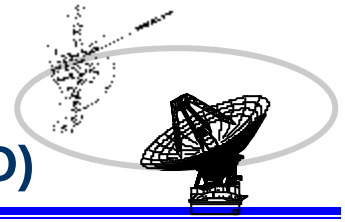


Schedule Creation Steps

Input Order and Other Additional Steps (2 Pages)

Input Order:

1. **"Mars Integrated Schedule"**
2. **Antenna Downtime**
3. **Antenna Maintenance**
4. **Longer Than 12 Hour Supports – Hardest Problem Is:**
   - **Reference Frame Calibration Star Catalog Maint. & Enhancement**
   - **2 Simultaneous Inter-Complex Antennas for 24 Hours**
5. **Antenna Calibrations**
6. **GSSR Asteroid or Other Specific Needs**
7. **SGP Has Specific Time Periods**
8. **Geotail Dump Windows**
9. **IMAGE "Stay Out Zone"**
10. **Voyager Key Events (Pre-timed)**



Schedule Creation Steps (Cont.)

- **Mission by Mission Copy From A Prior Week's Schedule**
  1. **Verify Requirements by Viewing Forecast Database Workbook for Non-Mars Missions**
  2. **Compare This With View Periods**
     - **View Periods Are Generally Not a Problem Anymore**
  3. **Adjust and Look at One Day at a Time**
- **Sort by Mission and Then Antenna Type**
  1. **Check Configuration Codes**
  2. **Set up and Teardown Times**
- **Once All of the Requirements Are In … (Using Specific Project Input, Experience and Database Verification)**
  1. **Look at Full Week Bar Chart to Identify Trouble Spots**
  2. **Minimize These Problems, If Possible, and Iterate Twice**
- **Resulting Schedule is Ready for Project Requirement Validation**
- **Left Over Conflicts Are Set up to Minimize the Resulting Impacts**
  - **Empowers the Project to Make Their Own Cuts**

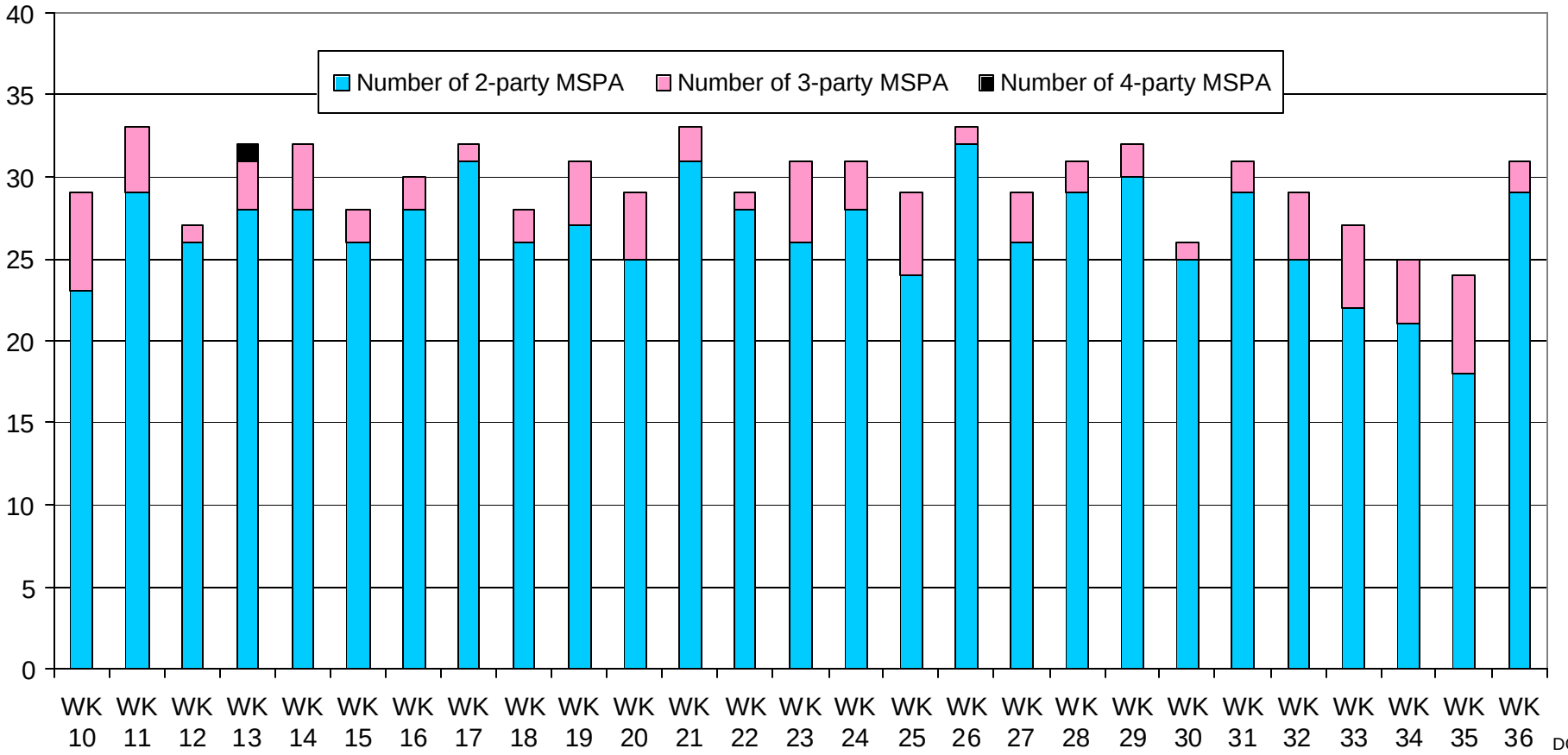
Preview Week Analysis:

Preview Weeks	WK 27	WK 28	WK 29	WK 30	WK 31	WK 32	WK 33	WK 34	WK 35	WK 36	WK 37	Mean
Number of Passes in Week	355	368	357	364	344	355	370	357	354	370	369	360
Conflict Evaluation:												
2 Party Conflicts	17	13	26	35	17	19	17	11	14	25	14	19
3 Party Conflicts	4	5	5	6	9	4	11	8	4	6	15	7
4 Party Conflicts	0	0	0	1	0	1	4	1	0	4	1	1
5 Party Conflicts	0	0	0	0	0	0	1	2	0	0	0	0
Summary Data:												
Number of Conflicts	21	18	31	42	26	24	33	22	18	35	30	27
3 or Larger Party Conflicts	4	5	5	7	9	5	16	11	4	10	16	8
Larger Party Conflicts/Conflicts	19%	28%	16%	17%	35%	21%	48%	50%	22%	29%	53%	31%

- **On Average 31% of the Conflicts Involve 3 or More Missions**
- **Key Conflicts Are:**
  - **ViewPeriod – None in this Sample**
  - **Facility – Too Many Users On an Antenna**
  - **SOA / BOT – Exceeds Operational Limit of Simultaneous Activities at a Complex**
  - **Equipment – Not Counted Because It Clouds the Issue**
  - **– First Need to Clear Facility, Start of Activity & Beginning of Track**

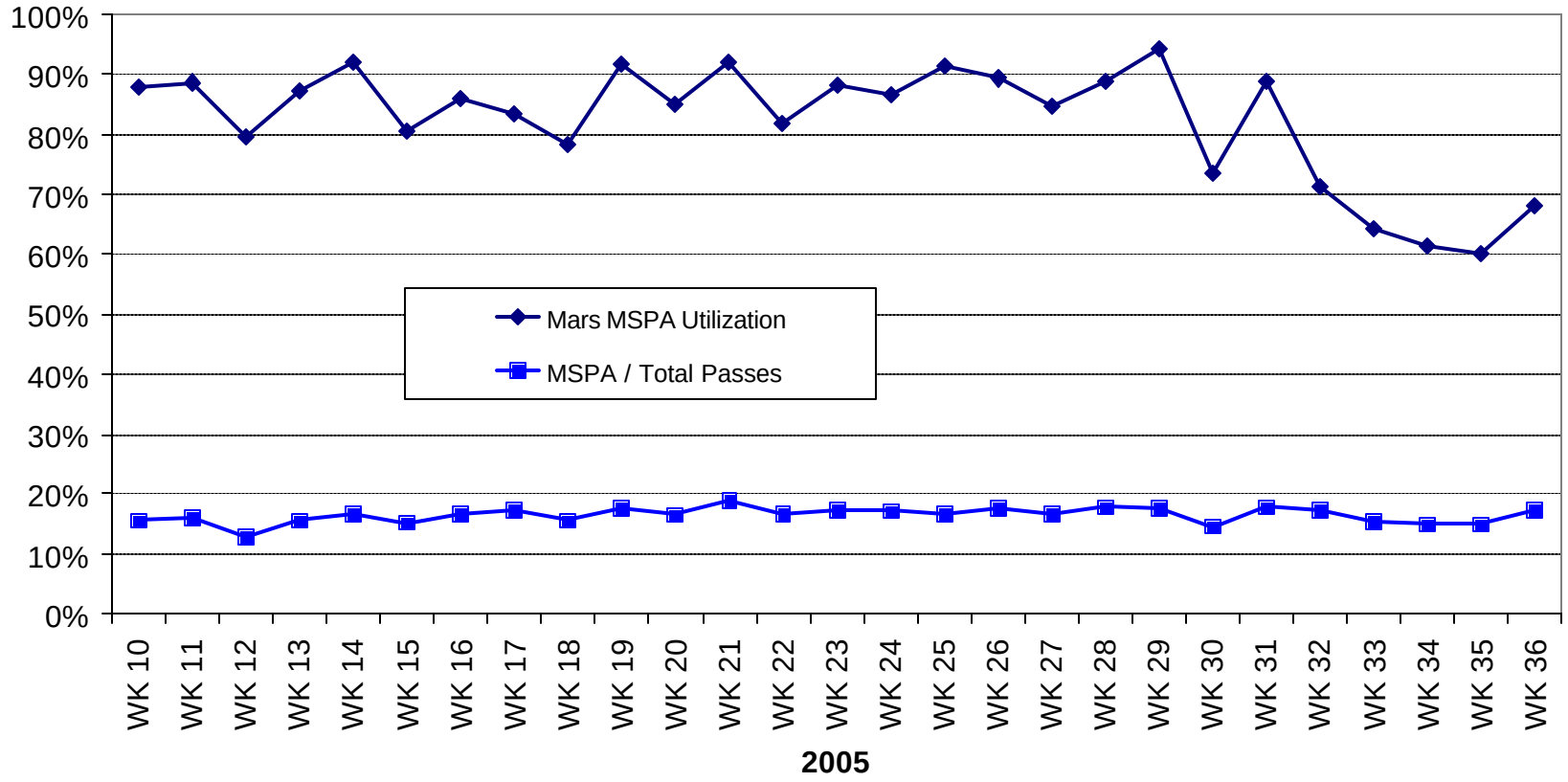
26 Week MSPA Survey:

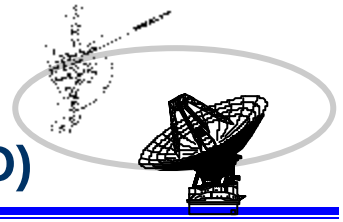
- **Average 30 MSPA tracks per week**
- **Average 4.2 MSPA tracks per day**



26 Week MSPA Survey:

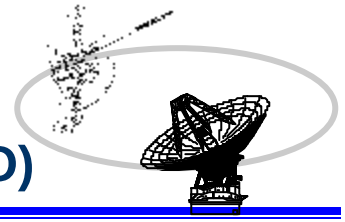
- MSPA Average 82% of the Mars Total Passes
- MSPA Average 17% of the Total Week's Tracks
- Mars Missions Average 20% of the Total Week's Tracks
- Average Number of Tracks Per Week Are 378 Passes





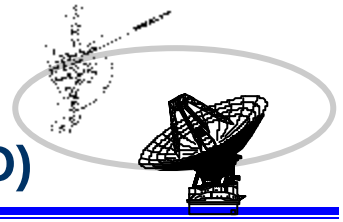
Results:

- **RARB Analysis:**
  - **Most Significant Cause of Change Due to HQ Mission Set Changes**
  - **52% of Recommendations Delete or Reduce Tracks**
- **Preview Weeks:**
  - **31% Of Conflicts Involve Three Or More Missions**
- **MSPA Metrics:**
  - **Incredible Utilization – 82% of All Mars Tracks During 6 Months**
- **Study Concerns:**
  - **Only Sampled a Single Representative Month in RARB Analysis**
    - **A More Crowded Month May Find Different Results**
  - **Only 11 Preview Weeks Were Sampled**
    - **Larger Sample May Provide Better Clues to Complexity**



Summary

- **This Study Aimed To Evaluate the Complexity Needed Of a Future DSN Scheduling System By Examining a Sample Of Current Process Products**
- **It Objectively Analyzed RARB Recommendations Over Multiple Epochs**
- **It Quantified the Conflicts and the Number Of Parties Involved In Them Upon Initial Generation**
- **Provide Comparative Statistics For Planned and Scheduled Periods On a Per Week Basis**
- **MSPA Was a Very Good Investment!**



“Effectiveness and efficiency do not mean the same thing. Efficiency is doing things right. Effectiveness is doing the right things.”

- Peter Drucker

Backup Slides

- RARB Source Data for June 2006
  - Changes Affecting Past RARB
  - Current Downtime Chart for 2006
  - Events from February 2005 RARB
  - Recommendations and Analysis Pages from Past RARB
- Study Request

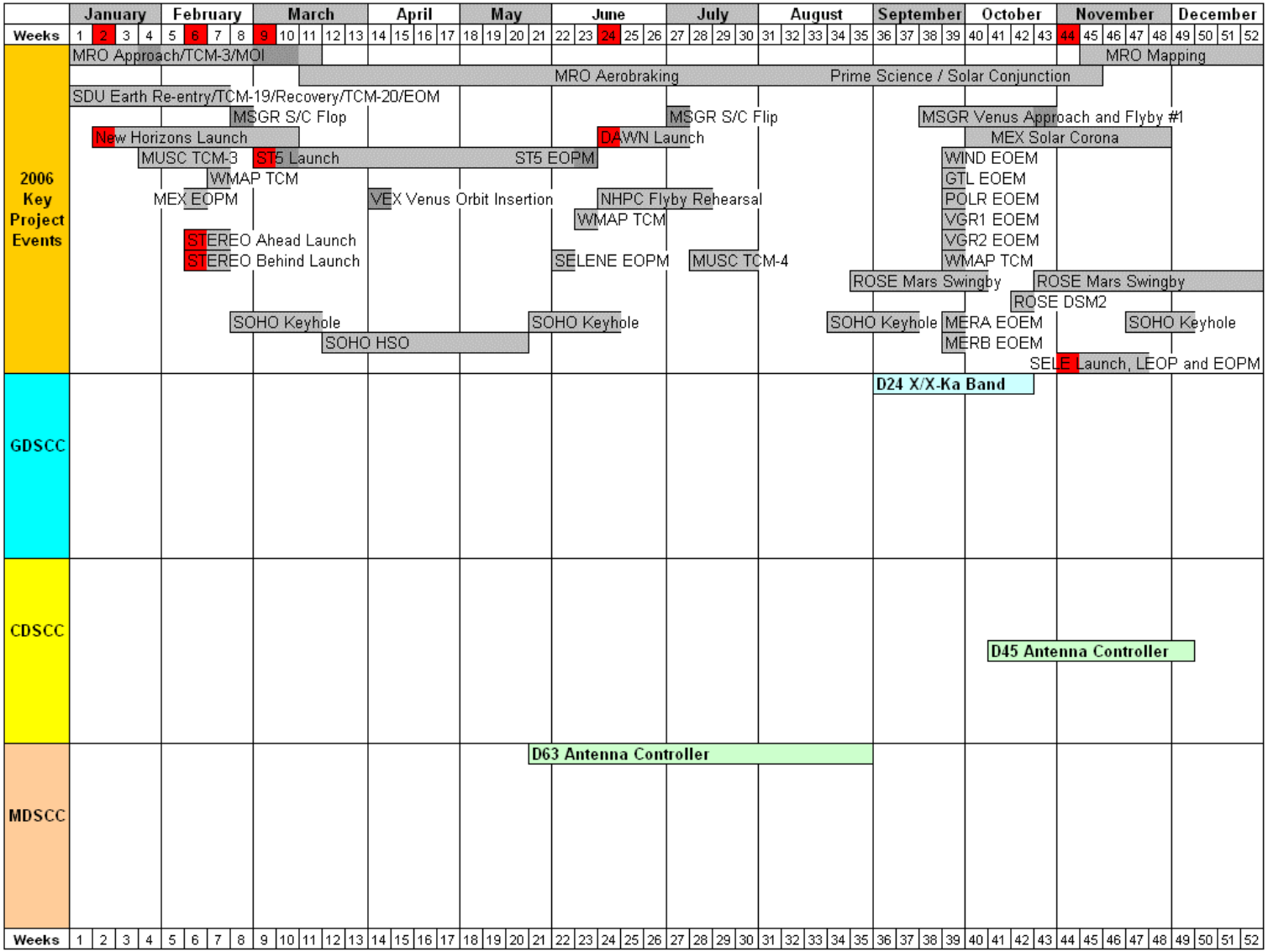
Changes Affecting Past RARB

RARB	Project	Requirement Change
200502		
	CLU2	EOM now 12/31/09 from 2/28/06
	MER	Spirit and Opportunity EOM now 9/30/06 from 10/8/05
	MGS	added continuous coverage requirement
	Polar	EOM now 9/30/06 from 9/30/05
	ST-5	Added requirements to Mission Set; EOM is 6/11/06
	VEX	Added to Mission Set; EOM now 4/9/06 from 8/19/07
	WIND	EOM now 9/30/06 from 9/30/05
200408		
	GSSR	added eight 8-hour Asteroid supports
	MEX	added 7 passes per week at GDS 70M or 34M for Orbital Sci.
	RFC	added 6 and 24 hour X/Ka supports every 6 weeks on 34m
	STF	changed from 34m to 70m
	WIND	EOM now 9/30/05 from 12/31/08
200402		
	CLU2	EOM now 2/28/06 from 9/30/07
	DAWN	launch changed from 5/27/06 to 6/17/06
	Polar	EOM now 9/30/05 from 9/30/07
	SGP	rescinded prior agreement from 3-8hr passes to 24-hr passes
	SOHO	added keyhole support definition to June (24)

Changes Affecting Past RARB

RARB	Project	Requirement Change
200308		
	DSS	DSS-63 Downtime
	MEGA	EOM now 12/31/08 from 12/31/03
	ULYS	EOM now 12/31/06 from 9/30/04
	Rosetta	Added to Mission Set - 02/26/04 to 12/31/2015
	VGR2	Added ASCAL and MAGROL events (2005-2007)
	NOTE:	All Setup and Teardown times were restored from a NSP expected std. 30min to 45, 60 and 75 min. as before.
200302		
	ACE	EOM now 9/30/07 from 1/31/05
	CLU2	EOM now 9/30/07 from 9/19/05
	GBRA	DSS63 host country now weekly 8 hours from quarterly 24 hours
	Geotail	EOM now 9/30/07 from 9/30/05
	IMAGE	EOM now 9/30/07 from 5/30/04
	M01O	changed to 70m from 34m and to 10 hours from 8 hours
	MGS	EOM now 1/03/08 from 6/01/04
	Pioneer 10	EOM now 10/1/04 from 9/30/08
	Polar	EOM now 9/30/07 from 9/30/05
	SOHO	EOM now 9/30/07 from 12/31/05
	STF	EOM now 9/30/07 from 9/30/05
	VGR1	EOM now 9/30/07 from 12/31/05
	VGR2	EOM now 9/30/07 from 12/31/05
	WIND	EOM now 9/30/07 from 9/30/05

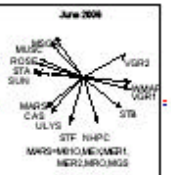
February 2005 RARB: 2006 Downtime Chart



Revised: January 12, 2005

February 2005 RARB: June 2006 Events

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26)



EVENTS

DSS-63 approved downtime (antenna controller replacement)

ATOT Mission 24-hour Event beginning in week 26

Chandra Earth Eclipse beginning in week 26

Cassini Tour

Dawn Launch and Initial Acquisition in week 24, DOY 168 and Launch support in weeks 25 and 26

EGS Global VLBI Quarterly Epoch in weeks 23 – 24 at DSS-14&63

GSSR Asteroid 2004 DC in weeks 22 – 23, Lunar Pole Observations in week 25 at DSS-14/15 and Mercury Radar Observation in weeks 23 – 26

Mars Express Bi-Static Radar in week 24 and Orbital Science

Mars Reconnaissance Orbiter Aerobraking continuous

SOHO Keyhole event ending in week 24, DOY 184

ST5 End of Prime Mission in week 23, DOY 162

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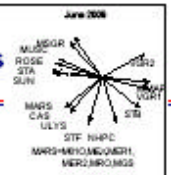
Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26)



EVENTS

STEREO Ahead Prime Science and SECCHI Campaign beginning in week 24

STEREO Behind Prime Science and SECCHI Campaign beginning in week 24

Voyager 2 MAGROL in week 24, DOY 167

Wilkinson Microwave Anisotropy Probe Maneuver in week 26

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February 2005 RARB: Recommendations and Analyses

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

RECOMMENDATIONS

- CLU2 SSO change support from DSS-16/27/24/15/14 array to DSS-16/27/24 and from DSS-46/34/45/43 to DSS-46/34/43 in weeks 22 – 24. (1,2)
- M01O Mapping and MSPA with MGS Mapping reduce the pass duration of 4 to 5 passes from 12 hours to 10 hours and move from DSS-14 to DSS-14,43. Move 1 pass per week in weeks 23 – 25 and 2 passes in week 26 from DSS-43 to DSS-14,43 and increase pass duration from 8 hours to 10 hours. Delete the remaining 1 to 2 passes at DSS-43. MSPA 3 to 4 passes in week 22, 24 – 26 at the 34BWG2 and 1 to 2 passes at DSS-25,26 in weeks 23 and 25 – 26 with MGS Mapping D/L. (1,4)
- MGS Mapping and MSPA with M01O reduce the pass duration of 4 to 5 passes from 12 hours to 10 hours and move passes from DSS-14 to DSS-14,43. Move 1 pass per week in weeks 23 – 25 and 2 passes in week 26 from DSS-43 to DSS-14,43 and increase pass duration from 8 hours to 10 hours. Delete the remaining 1 to 2 passes at DSS-43. Move 3 passes in week 22 from the 34BWG1 subnet and 4 passes in weeks 24 – 26 from DSS-15,45,55 to the 34BWG2 subnet and MSPA with M01O Mapping. Move 2 passes in week 23, 1 to 2 passes in weeks 25 and 26 from the 34BWG1 subnet to DSS-25,26 and MSPA with M01O Mapping. (1,3,4)
- STA Prime Science move 2 of 7 passes from the 34HEF to DSS-15,65,34 and move the remaining 5 passes to DSS-25,34,55 in weeks 25 and 26. (2,3,4) JDI
- STB Prime Science move 4 of 7 passes from DSS-26,34,54 to the 34HEF in week 26. (2,3,4) JDI

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

ANALYSES

1. (70M) The projected unsupportable time ranges from moderate to extreme. The unsupportable time is moderate to severe for DSS Routine and Bearing Maintenance and M01O Mapping and MSPA with MGS Mapping in all weeks and extreme for GSSR Asteroid 2004 DC in week 23. The unsupportable time is moderatefor SOHO Keyhole events in weeks 22 and 23, STF, ULYS, and VGR2 routine supports. The projected unsupportable time is due to view period overlap in the Mars and Sun view period and oversubscription at DSS-14.
2. (34HEF) Moderate to extreme unsupportable time is projected for DSS Maintenance; Moderate to severe for DAWN Launch and Launch support in week 24; moderate for CLU2 SSO, MSGR Cruise, SOHO Keyhole events, STA Prime Science, and VGR2. The projected unsupportable time is due to view period overlap in the Sun view period compounded by DAWN Launch supports and RFC CAT M&E simultaneous 24 hour requirements.
3. (34BWG1) The projected unsupportable time is moderate to severe for DSS Maintenance, ULYS in week 23, and WIND and moderate for NHPC Cruise, SOHO Keyhole events, STA Prime Science and VGR2 routine supports. The projected unsupportable time is due to view period overlap in the Sun view period.

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

RECOMMENDATIONS

- ULYS move 3 to 4 of 7 passes from DSS-43 to DSS-14,43 in weeks 22 and 24 – 26 and move 2 of the remaining 4 passes to DSS-24 in weeks 24 and 25. Move 3 of 7 passes from DSS-24,34 to DSS-14,43 and move 2 of the remaining 4 passes to DSS-24 in week 23. (1,3) JDI
- VGR1 move all passes from DSS-55 to DSS-55,65 in weeks 22 and 24. Move all passes from DSS-55 to DSS-65 in week 23. (2,4) JDI
- VGR2 delete all 6 to 8 hour routine passes at DSS-43, DSS-43,45 and at DSS-43,34 and add three to four 6-hour passes at DSS-43,45,34. (1,2,3) JDI

Note:

RFC CAT M&E S/X 24-hour support at DSS-15\45 in week 24 and DSS-15\65 in week 25 will require accommodation from the following projects/users directly or indirectly during the Mid-Range Scheduling negotiation process: CAS, CLU2, DAWN, MGS, MRO, MSGR, SOHO, STA, STB, VGR1 and VGR2.

RFC CAT M&E X/Ka 24-hour support at DSS-26\34 in week 22 will require accommodation from the following projects/users directly or indirectly during the orbital Mid-Range Scheduling negotiation process: CAS, CLU2, CHDR, IMAG, M01O, MEX, MGS, MRO, MSGR, NHPC, STA, STB, ULYS, VGR1, VGR2 and WIND.

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

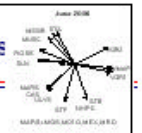
ANALYSES

4. (34BWG2) Moderate unsupportable time is projected for DSS-Maintenance, MGS Mapping D/L, STB Prime Science and SECCHI Campaign, and for VGR1 routine supports. The projected unsupportable time is due to view period overlap in the Sun and Mars view period.

Contention levels on the 34HSB and 26M subnets are workable and should resolve during final schedule preparation and negotiations.

August 2004 RARB: Events, Recommendations and Analyses

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26)



EVENTS

DSS-63 approved downtime (antenna controller replacement)

Cassini tour

Dawn Launch and initial acquisition in week 24, DOY 168 and Launch support in weeks 25 and 26

EGS Global VLBI quarterly epoch at DSS-14\63 beginning in week 22

Goldstone Solar System Radar Asteroid 2004 DC and Mercury Radar observation

Mars Express bi-static radar in week 20 and Orbital Science

Mars Reconnaissance Orbiter aerobraking continuous support

SOHO Keyhole event ending in week 24, DOY 184

STEREO Ahead Prime Science and SECCHI campaign beginning in week 24

STEREO Behind Prime Science and SECCHI campaign beginning in week 24

Voyager 2 MAGROL in week 24, DOY 167

Wilkinson Microwave Anisotropy Probe maneuver in week 23

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

RECOMMENDATIONS

- MGS delete 34BWG1 and 34BWG2 4 hour standalone passes and MSPA three 8-hour passes with MEX at DSS-15,25,26. Maximize MSPA capability to meet requirements will be implemented wherever possible. (3,4)
- MRO delete the three 34HEF passes in week 25, 6 to 7 passes at DSS-15,45,55 in weeks 24 – 26. To maintain continuous coverage, add 2 passes in week 24 and add 3 passes in weeks 25 and 26 at DSS-24,43,55. Add 5 passes in week 24, 4 passes in week 25 and add 3 passes in week 26 at DSS-25,26,34,54. (2,4)
- SOHO Keyhole move 7 passes from the 70M/26M to the 34HEF/26M in weeks 22 and 23 and delete 3 of 6 passes at the 34BWG1 in week 24. Additional support during the keyhole periods will be added on a best efforts basis at 70M/26M and or 34H/26M in Mid-range Scheduling. (1,3)
- STA Prime Science move passes from DSS-25,34,55 to 34HEF in weeks 24 – 26. (3,4)
- ULYS move from the 34BWG1 subnet to DSS-43 in weeks 22, 24 – 26. (3)
- VGR1 reduce pass duration from 8 hours to 4 hours at DSS-26 and from 8 hours to 6 hours at DSS-55 in weeks 24 – 26. (4)
- VGR2 reduce pass duration from 8 hours to 6 hours and move from DSS-43,45 to DSS-43,34 in week 25. Reduce all pass duration from 8 hours to 6 hours, move 2 of 5 passes from DSS-43,45,34 to DSS-43 and move the remaining 3 passes to DSS-43,34 in week 26. (1,2,3)

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

RECOMMENDATIONS

- ATOT Development delete all supports. (1)
- DSS Maintenance delete 1 of 2 routine maintenance supports per week at DSS-14 during the DSS-63 downtime. (1)
- EGS Global VLBI move the three 8-hour supports from week 22 to 1 support in week 23 and 2 supports in week 24. (1)
- GBRA Guest Observation delete all supports. Delete Host Country support at DSS-43 and DSS-45 and PRA-GAVRT CAL support. (1)
- GSSR Asteroid 2004 DC delete 3 of 6 supports in week 22. (1)
- M01O mapping MSPA with MGS mapping reduce all pass duration from 12 hours to 8 hours at DSS-14 in weeks 22 – 24. Move 1 pass each per week from DSS-14 to DSS-43 and move and MSPA the remaining passes with MEX at DSS-25,26,55 in weeks 22 – 24. Move 1 pass per week from DSS-43 to DSS-25,26,55 and MSPA with MEX in weeks 25 and 26. Maximize MSPA capability to meet requirements will be implemented wherever possible. (1)
- MEX move 3 passes from DSS-15,26 to DSS-25,26,55 and MSPA with MGS. Move 3 to 4 pass from DSS-15,26 to DSS-25,26,55 and MSPA with M01O in weeks 22 – 24. Move 1 pass from DSS-15,26 to DSS-25,26,55 and MSPA 1 pass per week with M01O in weeks 25 and 26. Maximize MSPA capability to meet requirements will be implemented wherever possible. (1,2,4)

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

ANALYSES

1. (70M) The projected unsupportable time for this period is severe to extreme for DSS and Bearing maintenance, GBRA activities in week 23, M01O mapping MSPA with MGS mapping, SOHO Keyhole and maneuver, and STF routine support in week 23. The unsupportable time is caused by all view periods are overlapped by 80 to 90 percent and the approved downtime for DSS-63.
2. (34HEF) The projected unsupportable time is moderate for Dawn Launch and acquisition, MEX Orbital Science, and SGP and severe to extreme for DSS maintenance. The unsupportable time is caused by Dawn, MEX and daylight maintenance view periods overlap and the 24-hour SGP supports.
3. (34BWG1) The projected unsupportable time is moderate to severe for MGS mapping, MSGR cruise, SOHO Keyhole, STA Prime Science and SECCHI campaign, and routine supports for ULYS. The unsupportable time is caused by oversubscription in the daylight maintenance view period and the 24-hour simultaneous RFC CAT M&E support.
4. (34BWG2) MEX and MGS view periods overlap with DSS maintenance by 85 percent and with VGR1 by 75 percent which causes low to moderate unsupportable time for this period.

Contention levels on the 34HSB, and 26M subnets are workable and should resolve during final schedule preparation and negotiations.

February 2004 RARB: Events, Recommendations and Analyses

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26)

EVENTS

DSS-63 approved downtime (antenna controller replacement)

Cassini tour

Dawn launch and initial acquisition in week 24, DOY 168

Mars Express bi-static radar

Mars Reconnaissance Orbiter aerobraking continuous support

New Horizons flyby rehearsal beginning in week 24

SOHO keyhole event ending in week 24, DOY 184

STEREO Ahead prime science support

STEREO Behind prime science support

Voyager 2 MAGROL in week 24, DOY 167

Wilkinson Microwave Anisotropy Probe maneuver in week 23

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Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

ANALYSES

1. (70M) The projected unsupportable time is moderate to extreme for DSS routine maintenance, moderate for GBRA VLBA, MEX, M01O and MGS mapping, and ULYS due to view period overlap with daytime maintenance and Mars projects and the approved downtime for DSS-63 antenna controller replacement
2. (34HEF) The projected unsupportable time is moderate for DSS maintenance and VGR2. The contention is predominantly at DSS-45 and is due to view period overlap with Dawn launch phase support and MRO aerobraking.
3. (34BWG1) The projected unsupportable time is moderate to severe for DSS maintenance, SOHO keyhole and TSO events, ULYS, and WIND due to view period overlap.

Contention levels on the 34BWG2, 34HSB, and 26M subnets are workable and should resolve during final schedule preparation and negotiations.

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Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

RECOMMENDATIONS

☺ DSN reduce 70M and 34BWG1 antenna calibrations from 8 hours to 4.5 hours.

☺ CHDR move 7 of 21 passes per week from the 34BWG1 to the 26M subnet in weeks 22 – 25 and increase pass duration from 1 hour to 2 hours. (3)

GBRA reduce M-Wave Spectroscopy, New Proposals, and Planetary Radio Astronomy from 6 hours to 4.5 hours. (1)

☺ MGS reduce pass duration for 2 to 3 standalone passes per week from 10 hours to 8 hours and use split passes of 4 hours each on the 34BWG1 and at DSS-45,34B2. (1, 2, 3)

☺ NHPC move 2 cruise passes in week 24 from the 34BWG1 to DSS-26,55. (3)

☺ VGR2 reduce 3 to 4 passes in weeks 22 – 25 from 8 hours to 6 hours. (1, 2, 3)

02/10/2004 FINAL NI – 2.0 – 101

August 2003 RARB: Events, Recommendations and Analyses

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26)

EVENTS

DSS-63 proposed downtime (antenna controller replacement)

Cassini tour

Dawn launch support through week 24

EVN E500 J-M4 24 hour quarterly epoch at DSS-14\63 in week 22

Mars Reconnaissance Orbiter aerobraking continuous support

RadioAstron start of DSN support on the 70M in week 24

STEREO Ahead prime science

STEREO Behind prime science

Voyager 2 MAGROL maneuver at DSS-43 in week 24, DOY 167

Wilkinson Microwave Anisotropy Probe maneuver in week 23

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

RECOMMENDATIONS (continued)

MGS move four to five passes from 34BWG1 in week 22 and four to five passes from 70M,34BWG1 in weeks 23 – 26 to DSS-14, increase pass duration from 10 hours to 12 hours, and MSPA with M01O. Move two to three passes from 70M,34BWG1 to DSS-43, reduce pass duration from 10 hours to 9 hours, and MSPA with M01O. Move remaing two to three standalone 70M,34BWG1 passes to 34BWG1. (1, 2)

MRO move two to four 70M passes to DSS-43 and move two passes to the 34HEF in week 22. Move four to five passes from 34BWG1,34BWG2 to the 34BWG1. Move three to four passes per week from DSS-15,45,55 to the 34HEF. (1, 2, 3)

SGP delete DSS-45 support in week 22. (2)

☺ STF move passes from the 70M to DSS-14,43. (1)

☺ ULYS reduce passes from 10 hours to 6 hours and move from 70M to DSS-34 in week 22, reduce all passes in weeks 23 – 26 from 10 hours to 6 hours, move passes in weeks 23 – 25 and two passes in week 26 to DSS-43,34, and move remaining 2 passes in week 26 to DSS-34. (1, 2)

☺ VGR1 move routine U/L support from DSS-14,63 to DSS-14. (1)

WMAP move routine and maneuver passes from the 70M to DSS-14,43. (1)

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

RECOMMENDATIONS

Approve DSS-63 downtime.

☺ CAS move week 22 passes from DSS-15,24,26,54,55,65 to DSS-24,26,55 (2, 3)

☺ DSS delete 1 of 2 DSS-14 routine maintenance support in week 25. (1)

EVN delete DSS-63 calibration and DSS-14\63 array supports in weeks 22 and 23. (1)

GBRA reduce M-wave spectroscopy and new proposals support from 9 hours to 6 hours. Reduce planet R/AST supports from 9 hours to 4 hours. Delete DSS-14\63 VLBA array, reduce support from 10 hours to 8 hours, and use DSS-14. (1)

GSSR reduce support from 5.2 hours to 4 hours, move 1 Mercury support from week 24 to week 25, and delete one of two supports in week 26. Reduce GODR supports from 8 hours to 4 hours in weeks 24 and 26. (1,2)

M01O MSPA all seven passes with MGS, move 4 to 5 passes to DSS-14, and increase pass duration from 10 hours to 12 hours. Move remaining two to three passes to DSS-43, reduce duration from 10 hours to 9 hours and MSPA with MGS. (1)

Resource Allocation Review Board
Events, Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

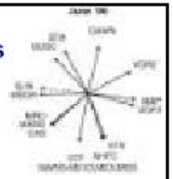
ANALYSES

1. (70M) proposed DSS-63 downtime for ACR is in contention with DSN antenna calibration, DSS bearing and routine maintenance, EVN simultaneous quarterly epoch at DSS-14\63, GBRA Host Country, M-wave spectroscopy, new proposals, and VLBA SOC-M4 at DSS-14\63, M01O mapping, MGS mapping, STF routine support, ULYS routine support, VGR1 routine U/L support, and WMAP routine support. The projected unsupportable time for DSS-14 and DSS-43 routine and bearing maintenance is moderate to severe due to viewperiod overlap with Mars Missions and impact of the proposed downtime for DSS-63.
2. (34HEF) The projected unsupportable time for DSS Maintenance in weeks 22 and 25 is moderate to severe due to RFC CAT M&E 24-hour simultaneous support, SGP crustal dynamics 24-hour supports, viewperiod overlap with MRO aerobraking continuous support, SOHO TSO, and impact of the proposed downtime for DSS-63.
3. (34BWG2) The projected unsupportable time for DSS Maintenance in weeks 23 – 25 is moderate due to viewperiod overlap with MRO aerobraking continuous support, and impact of the proposed downtime for DSS-63.

Contention levels on the 34BWG1, 34HSB, and 26M subnets are workable and should resolve during final schedule preparation and negotiations.

February 2003 RARB: Events, Recommendations and Analyses

Resource Allocation Review Recommendations and Analyses
2006 – June (Weeks 22 - 26)



EVENTS

Cassini tour

Dawn launch support through week 24

EVN E500 J-M4 24 hour quarterly event at DSS-14\63 in week 22

MAP maneuver in week 23

Mars Reconnaissance Orbiter aerobraking continuous support

RadioAstron start of DSN support on the 70M subnet in week 24

SELENE OCM in weeks 23 - 24, DOY 156 - 169

Stereo Ahead prime science

Stereo Behind prime science

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Resource Allocation Review Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

ANALYSIS

1. (70M) The projected unsupportable time is moderate for DSS bearing and routine maintenance in weeks 22, 25, and 26 due to the Mars Missions viewperiod overlap into the daylight maintenance viewperiod, EVN 16-hour simultaneous supports at DSS-14\63, GSSR GODR simultaneous supports at DSS-14/15, and GSSR Mercury support at DSS-14.
2. (34HEF) The projected unsupportable time is moderate to severe for this period. The contention level is caused by the Mars Reconnaissance Orbiter viewperiod overlap with the DSS daylight view. Mars Reconnaissance Orbiter is requesting continuous support for aerobreaking, GSSR GODR request simultaneous supports at DSS-14/15, RFC CAT M&E 24-hour simultaneous support, Space Geodesy 24-hour support, and Voyager 2's viewperiod constraint at Canberra.

Contention levels on the 34BWG1, 34BWG2, 34HSB, and 26M subnets are workable and should resolve during final schedule preparations and negotiations.

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Resource Allocation Review Recommendations and Analyses
2006 – June (Weeks 22 - 26) (continued)

RECOMMENDATION

« DSS » reduce DSS-14 routine maintenance from two 8-hour supports to one 8-hour support, and reduce DSS-25 and DSS-26 maintenance from 8-hours to 6-hours in week 22. (1)

EVN reduce support from two 16-hour supports to two 8-hour supports in week 22 and add two 8-hour supports in week 23. (1)

« GSSR » GODR delete simultaneous support in week 22, reduce support in weeks 24 and 26 from 8 hours to 4 hours and delete GSSR Mercury support in week 25. (1, 2)

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Study Request

- … I went and began studying the RARB contention analyses and recommendations, and discovered the following:

  Take, for example, one 5 week period (June of 2006, weeks 22 through 26);

  For weeks 22-26 (June) of 2006 the following is true:

  In the 8/12/2003 RARB there are 13 recommendations

  In the 2/10/2004 RARB there are 6 recommendations

  In the 8/10/2004 RARB there are 14 recommendations

  In the 2/8/2005 RARB there are 8 recommendations

- This is an average of 10.25 recommendations throughout all the RARBs from 8/12/2004. If you look at each recommendation as resolving a conflict (i.e., a mirror on the number of conflicts that exist), then it appears that on the average there is ~2+ conflicts/week. This leads to some interesting questions. As a result, I asked Mike Rodrigues (he agreed) that we have a special study done to truly characterize the problem (the real virus - conflicts) instead of describing all the resulting problems caused by the virus (as we did in VSM and the RAP Working Group). I asked that Dave Morris be assigned to do the study and Mike agreed. The study outline is the second attached sheet. I would also ask, if she's willing, that Belinda Arroyo to assist or guide him. I will provide a charge number.

- As you can see from the attached sheet, If the true conflicts may be classified as 2 s/c conflicts, 3 s/c conflicts, etc. (we might be able to get at a realistic algorithm and implementation approach), and if they can determine what would of happened if there were no RARBs (i.e., do the conflicts accumulate? or do a certain number of them disappear or both, and how many?, etc.), then maybe the scheduling problem is over inflated and the real problem isn't developing sophisticated conflict resolution environments nor sophisticated scheduling engines, but rather, developing a sound data management system that is easy to use and that allows visualization of all Project requirements by all users (e.g. as described in Appendix D), and no longer have a privately held database not visible to Project users

- email from R. Bartoo, dated 2/14/2005

February 11, 2005

1. Study needed: would like by March 15th (no contractor involvement) **Exclude the ACP period.**

2. Trace recommendations made in the RARBs identified back to the original conflict for each period (or a statistically significant sample where possible). Characterize that conflict as a 2 s/c conflict, 3 s/c conflict, etc.

3. Determine the possible disposition of that conflict if a recommendation had not been made (i.e., would it have persisted until real-time, or would have disappeared, and if so when and why- if known)

4. Cover RARBs starting in Feb 2002

5. After identifying the conflicts in each four-week period covered by the RARB and applying step #3. Report the data in the following way:

e.g.

Period	Feb 2002	August 2002	Feb 2003	Aug 2003	Feb 2004	Aug 2004	Feb 2005
.							
.							

2006

June (22-26) total number of conflicts/RARB for which recommendations were made
of 2 S/c conflicts/RARB for which recommendations were made
of 3 s/c conflicts/RARB for which recommendations were made
etc.
2 s/c Conflict s for which if no recommendation would have been made would have persisted
2 s/c conflicts for which if no recommendation would have been made would have gone away anyway
3 s/c Conflict s for which if no recommendation would have been made would have persisted
3 s/c conflicts for which if no recommendation would have been made would have gone away anyway
etc.
.
.

To explain:

In the following images, for weeks 22-26 (June) of 2006 the following is true:
In the 8/12/2003 RARB there are 13 recommendations
In the 2/10/2004 RARB there are 6 recommendations
In the 8/10/2004 RARB there are 14 recommendations
In the 2/8/2005 RARB there are 8 recommendations

This is an average of 10.25 recommendations….if you look at each recommendation as resolving a conflict (i.e., a mirror on the number of conflicts that exist), then it looks like there is an average ~2+ conflicts/week.